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JOURNAL ARTICLE

Immunolocalization of NBC3 and NHE3 in the rat epididymis: colocalization of NBC3 and the vacuolar H⁺-ATPase

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In the male reproductive tract, the epididymis plays an important role in mediating transepithelial bicarbonate transport and luminal acidification. In the proximal vas deferens, a significant component of luminal acidification is Na⁺-independent, and mediated by specific cells that possess apical vacuolar proton pumps. In contrast, luminal acidification in the cauda epididymidis is an Na⁺-dependent process.

The specific apical Na⁺-dependent H⁺/base transport process(es)

responsible for luminal acidification have not been identified. A potential clue as to the identity of these apical Na⁺-dependent H⁺/base transporter(s) is provided by similarities between the transport properties of the epididymis and the mammalian nephron. Specifically, the H⁺/base transport properties of caput epididymidis resemble the mammalian renal proximal tubule, whereas the distal epididymis and vas deferens have characteristics in common with renal collecting duct intercalated cells. Given the known expression of the Na⁺/H⁺ antiporter, NHE3, in the proximal tubule, and of the electroneutral sodium bicarbonate cotransporter, NBC3, in renal intercalated cells, we determined the localization of NHE3 and NBC3 in various regions of rat epididymis. NBC3 was highly expressed on the apical membrane of apical (narrow) cells in caput epididymidis, and light (clear) cells in corpus and cauda epididymidis. The number of cells expressing apical NBC3 was highest in cauda epididymidis. The localization of NBC3 in the epididymis was identical to the vacuolar H⁺-ATPase. The results indicate that colocalization of NBC3 and the vacuolar H⁺-ATPase is not restricted to kidney intercalated cells. Moreover, the close association of the two transporters appears to be a more generalized phenomenon in cells that express high levels of vacuolar H⁺-ATPase. Unlike NBC3, NHE3 was most highly expressed on the apical membrane of all epithelial cells in caput epididymidis, with less expression in the corpus, and no expression in the cauda. These results suggest that apical NBC3 and NHE3 potentially play an important role in mediating luminal H⁺/base transport in epididymis.

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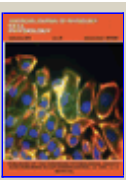
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Antibody-independent localization of the electroneutral Na⁺-HCO₃⁻-cotransporter NBCn1 (slc4a7) in mice
Am J Physiol Cell Physiol, February 1, 2008; 294(2): C591 - C603.
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V. Sharp, L. M Thurston, R. C Fowkes, and A. E Michael
11β-Hydroxysteroid dehydrogenase enzymes in the testis and male reproductive tract of the boar (*Sus scrofa domestica*) indicate local roles for glucocorticoids in male reproductive physiology
Reproduction, September 1, 2007; 134(3): 473 - 482.
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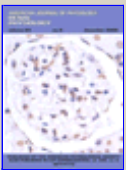
M. Donowitz and X. Li
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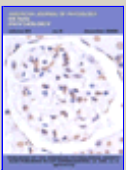
M. Kujala, S. Hihnala, J. Tienari, K. Kaunisto, J. Hastbacka, C. Holmberg, J. Kere, and P. Hoglund
Expression of ion transport-associated proteins in human efferent and epididymal ducts
Reproduction, April 1, 2007; 133(4): 775 - 784.
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S. Breton and D. Brown
New insights into the regulation of V-ATPase-dependent proton secretion
Am J Physiol Renal Physiol, January 1, 2007; 292(1): F1 - F10.
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Am. J. Physiol: Renal Physiology

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A. Pushkin and I. Kurtz
SLC4 base (HCO₃⁻, CO₃²⁻) transporters: classification, function, structure, genetic diseases, and knockout models
Am J Physiol Renal Physiol, March 1, 2006; 290(3): F580 - F599.
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



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N. Pastor-Soler, C. Pietrement, and S. Breton
Role of Acid/Base Transporters in the Male Reproductive Tract and Potential Consequences of Their Malfunction
Physiology, December 1, 2005; 20(6): 417 - 428.
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



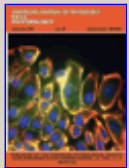
L. Hermo, D. L. Chong, P. Moffatt, W. S. Sly, A. Waheed, and C. E. Smith
Region- and Cell-specific Differences in the Distribution of Carbonic Anhydrases II, III, XII, and XIV in the Adult Rat Epididymis
J. Histochem. Cytochem., June 1, 2005; 53(6): 699 - 713.

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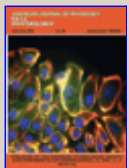
N. Pastor-Soler, V. Beaulieu, T. N. Litvin, N. Da Silva, Y. Chen, D. Brown, J. Buck, L. R. Levin, and S. Breton
Bicarbonate-regulated Adenylyl Cyclase (sAC) Is a Sensor That Regulates pH-dependent V-ATPase Recycling
J. Biol. Chem., December 5, 2003; 278(49): 49523 - 49529.

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D. Granger, M. Marsolais, J. Burry, and R. Laprade
Na⁺/H⁺ exchangers in the human eccrine sweat duct
Am J Physiol Cell Physiol, November 1, 2003; 285(5): C1047 - C1058.

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A. Pushkin, N. Abuladze, D. Newman, V. Muronets, P. Sassani, S. Tatishchev, and I. Kurtz
The COOH termini of NBC3 and the 56-kDa H⁺-ATPase subunit are PDZ motifs involved in their interaction
Am J Physiol Cell Physiol, March 1, 2003; 284(3): C667 - C673.

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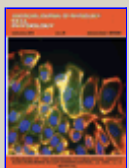
R. W. Carlin, J. H. Lee, D. C. Marcus, and B. D. Schultz
Adenosine Stimulates Anion Secretion Across Cultured and Native Adult Human Vas Deferens Epithelia
Biol Reprod, March 1, 2003; 68(3): 1027 - 1034.

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M. Park, S. B. H. Ko, J. Y. Choi, G. Muallem, P. J. Thomas, A. Pushkin, M. - S. Lee, J. Y. Kim, M. G. Lee, S. Muallem, *et al.*
The Cystic Fibrosis Transmembrane Conductance Regulator Interacts with and Regulates the Activity of the HCO₃⁻ Salvage Transporter Human Na⁺-HCO₃⁻ Cotransport Isoform 3
J. Biol. Chem., December 20, 2002; 277(52): 50503 - 50509.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

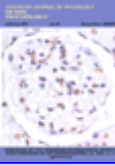


R. W. Carlin, R. R. Quesnell, L. Zheng, K. E. Mitchell, and B. D. Schultz
Functional and molecular evidence for Na⁺-HCO₃⁻ cotransporter in porcine vas deferens epithelia
Am J Physiol Cell Physiol, October 1, 2002; 283(4): C1033 - C1044.

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M. L. Phillips and B. D. Schultz
Steroids Modulate Transepithelial Resistance and Na⁺ Absorption
Across Cultured Porcine Vas Deferens Epithelia
Biol Reprod, April 1, 2002; 66(4): 1016 - 1023.
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



R. L. Sedlacek, R. W. Carlin, A. K. Singh, and B. D. Schultz
Neurotransmitter-stimulated ion transport by cultured porcine vas
deferens epithelium
Am J Physiol Renal Physiol, September 1, 2001; 281(3): F557 - F570.
[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)



Q. Zhou, L. Clarke, R. Nie, K. Carnes, L.-W. Lai, Y.-H. H. Lien, A. Verkman,
D. Lubahn, J. S. Fisher, B. S. Katzenellenbogen, *et al.*
From the Cover: Estrogen action and male fertility: Roles of the
sodium/hydrogen exchanger-3 and fluid reabsorption in
reproductive tract function
PNAS, November 20, 2001; 98(24): 14132 - 14137.
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